SUAEDA ESTEROA (CHENOPODIACEAE), A NEW SPECIES FROM ESTUARIES OF SOUTHERN CALIFORNIA AND BAJA CALIFORNIA

WAYNE R. FERREN, JR.
Department of Biological Sciences, University of California,
Santa Barbara 93106

SHERRY A. WHITMORE
Department of Biology, Allegheny College,
Meadville, PA 16335

ABSTRACT

A new species, **Suaeda esteroa,** is described from estuaries of southern California and Baja California, Mexico. Although numerous collections of this plant have been made during the last century, it has been confused previously with four other species of the genus. Most frequently, *S. esteroa* has been identified as *S. californica* var. *californica,* a plant restricted to the coast of central California. These two taxa are distinct morphologically, ecologically, and geographically. Recognition of *S. esteroa* as a species restricted to estuaries of southern California and Baja California emphasizes further the floristic difference between estuaries occurring to the north and south of Point Conception, Santa Barbara County. A key to the coastal central and southern California species of *Suaeda* is provided.

Taxonomy of *Suaeda* Forsk. ex Scop. (Chenopodiaceae), a genus restricted to saline or haline, primarily wetland soils, has been problematical for many years. In southern California, *Suaeda* has been considered to include anywhere from 3 species containing 7 taxa to 7 species containing 9 taxa (Watson 1874, 1880; Jepson 1914, 1923; Standley 1916; Abrams 1944; Munz 1959, 1974; Mason 1969; Hopkins and Blackwell 1977). The various treatments have differed not only on the assignment of rank, but also on the geographic limits of the taxa. The causes of inconsistencies among treatments of the genus can be attributed to several factors: material of each taxon, including type specimens, has not been available to or examined by all researchers; some species are quite variable morphologically; specimens are difficult to identify when pressed and dried; herbarium material often lacks important characteristics of the plants; and some researchers have made limited or no observations on the plants in their native habitats. One result of the varied interpretations of *Suaeda* in the taxonomic literature is the misapplication of names by biologists when preparing manuals, monographs, floras, and lists.

While conducting inventories of vascular plants from estuarine wetlands in southern California, the authors made numerous collections

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of *Suaeda*. Included among these is a new species, which in previous reports has been confused with other species of the genus.

Suaeda esteroa Ferren & Whitmore, sp. nov.

Plantae glaber, perennis, suffruticosus. Caules decumbens ad erectus, plerumque ramosissimus in inflorescentia, rami erectus. Folia linearis, ascendens, pagina adaxialis planus, pagina abaxialis convexus, sessilis, usque 6 cm longa, virens et plerumque non glaucus; plus lata basi folia, bractiformis, et abbreviatus (0.5–2 cm longa) in inflorescentia. Flores perfectus vel interdum unisexualis, 1.5–3 mm lata, (1–) 3–5 in uterque glomerulus ex axillae bractiformis folia in inflorescentia definate, subtendus a 1–5 bracteolae inaequalis, integromarginatus, scariosus; perianthium lobi 5, carinatus et cucullatus, cum appendices membranous marginatus, unus lobus magus quam alius lobi; staminea 5; styli (2–)3 partitum, glabrous, linearis. Fructifer calyces 2.5–3.5 mm lata. Semina horizontalis in ovarium, irregulariter biconvexus, fere orbicularis, porphyreus, nitens, 0.8–1 mm crassus, 1–1.3 mm latus, 1.2–1.5 mm elatus, pericarpium facile amotus (Fig. 1).

Plants glabrous, perennial, from several oblique to horizontal, generally shallow roots; axis up to 60 cm long, average ca. 40 cm. Stems decumbent to erect, suffruticose, up to 2 cm in diameter at base, straw-colored, often with exfoliations, usually much branched in inflorescence, branches erect and with short sharp alterations in course of axis in mature inflorescence. Leaves linear, ascending, entire-margined, acute-tipped, usually falcately curved, plane adaxially, convex abaxially, sessile, up to 6 cm long, succulent, green, yellow-green, or pale glaucous green, occasionally reddish; withering to straw color and becoming deciduous or persisting as vascular strands towards base of mature plant; broader at leaf base, bract-like, and shorter (0.5–2 cm long) in the inflorescence. Flowers perfect or occasionally unisexual, 1.5–3 mm broad (fresh material), (1–)3–5 per glomerule from bract-like leaf axils of well-defined inflorescence, subtended by 1–5 unequal, entire-margined, scarious bractlets; perianth lobes 5, carinate (keeled) and cucullate (hooded), with membranaceous marginal flanges; stamens 5; styles (2–)3-parted, glabrous, linear. Fruiting calyces 2.5–3.5 mm broad (fresh material). Seeds horizontal in ovary, irregularly biconvex, nearly orbicular, reddish-brown, shiny, 0.8–1 mm thick, 1–1.3 mm broad, 1.2–1.5 mm tall, pericarp easily removed.

Type: USA, California, Ventura Co.: clay substrate of salt marsh, vicinity of mean high tide along creek adjacent to n. shore, e. arm of Mugu Lagoon; ca. 0.1 km w. of Rt. 1 and 2 km se. of Las Posas Rd., Pacific Missile Testing Center, Pt. Mugu Naval Air Station; 34°06′15″N, 119°05′W; 10 Sep 1980, *S. A. Whitmore & W. R. Ferren 2343* (Holotype: UCSB; isotypes: CAS, GH, MEXU, RSA, SD, UC, US).

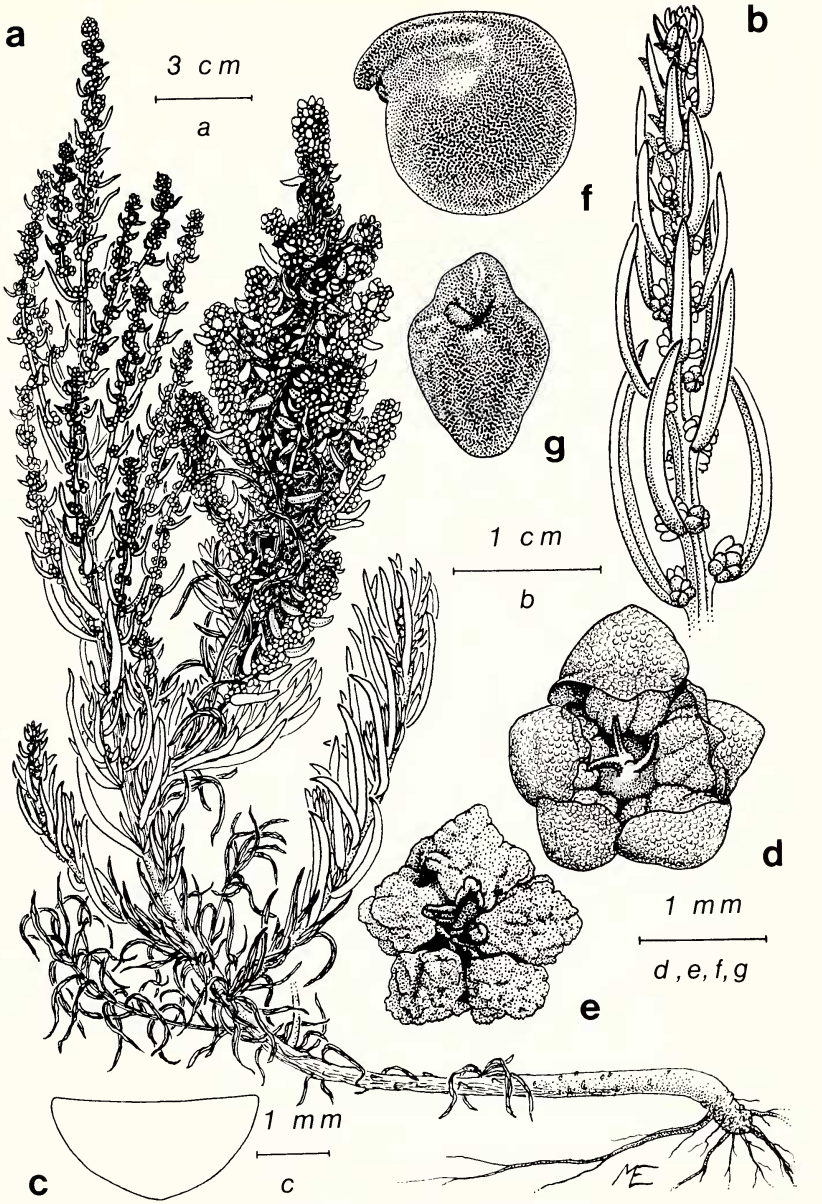

FIG. 1. *Suaeda esteroa*. a. Habit. b. Branch of inflorescence. c. ×-section of leaf. d. Pre-anthesis flower, fresh material. e. Pre-anthesis flower, herbarium material. d. Seed, orbicular outline. g. Seed, irregularly biconvex view.

PARATYPES: Mexico, Baja California Norte: Laguna Mormona, 16 Sep 1970, *Neuenschwander 7* (RSA, SD); San Quintin Bay, 17 Jan 1973, *Moran 19468* (SD); Laguna Manuela, 25 Jan 1972, *Moran 19073* (SD); Bahia de los Angeles, 24 Nov 1973, *Mudie 1061* (SD); Baja California Sur: Scammon's Lagoon, 9 Jan 1973, *Anderson 3227* (RSA); Abreojos Lagoon, 20 Apr 1972, *Mudie 759* (SD); Estero de la Laguna, 25 Apr 1972, *Mudie 804* (SD); El Coyote Lagoon, 22 Apr 1972, *Mudie 768* (SD); Estero Salinas, 22 Nov 1946, *Wiggins 11489* (UC); Puerto Chale, 2 May 1972, *Mudie 855* (SD); USA, CA, Los Angeles Co.: Long Beach, 12 Jul 1900, *Jones s.n.* (POM); Anaheim Landing, 10 Jul 1930, *Fosberg S3179* (LAM); San Pedro, 6 Sep 1904, *Abrams 4195* (DS, POM); Orange Co.: Balboa Beach, 10 Feb 1924, *Peirson 4535* (RSA); Bolsa Bay, 25 Jul 1970, *Henrickson 5029* (RSA); Newport Backbay, 27 Aug 1980, *Ferren 2333 & Whitmore* (UCSB); Seal Beach, 19 Sep 1925, *Jones s.n.* (POM); Surfside, 28 Sep 1957, *Raven 11383* (CAS); San Diego Co.: Chula Vista, 25 Jul 1938, *Keller s.n.* (POM); Coronado, 29 Apr 1919, *Cooper 306* (JEP); San Diego, Mar 1875, *Cleveland s.n.* (SD); Imperial Beach, 28 Oct 1938, *Purer 7889* (SD); National Ranch, 5 Jan 1884, *Cleveland s.n.* (SD); Silver Strand, 7 May 1938, *Gander 5488* (SD); Santa Barbara Co.: Goleta, 21 Oct 1964, *Pollard s.n.* (CAS, LAM, SBBG); Ventura Co.: Pt. Mugu, 4 Oct 1959, *Raven & Thompson 14609* (RSA, CAS).

Suaeda esteroa is confined to estuaries of southwestern North America from Goleta Sough, Santa Barbara County, California, south at least to Almejos Bay, Baja California Sur, Mexico (Fig. 2). It grows frequently in clay, silt, and sand substrates just above mean higher high water level of salt marshes. These upper marshlands are classified as Irregularly Flooded Estuarine Emergent Wetlands of the California Province (Cowardin et al. 1979). *Suaeda esteroa* is one of several plants in southern California and Baja California that characterize the lower portion of this wetland. Based on the occurrence of *S. esteroa,* the entire upper marsh, located between mean higher high water and extreme high water, has been called the Suaedetum flora assemblage or Upper Littoral Zone (Stevenson and Emery 1958; Henrickson 1976). Plants commonly associated with *S. esteroa* in this zone in California include *Batis maritima* L. (in lower areas), *Cuscuta salina* Engelm., *Distichlis spicata* (L.) Greene var. *spicata, Frankenia grandifolia* Cham. & Schlecht. var. *grandifolia, Jaumea carnosa* (Less.) Gray, *Limonium californicum* (Boiss.) Heller, *Monanthochloe littoralis* Engelm., *Salicornia virginica* L., and *Triglochin concinna* Davy. var. *concinna.* In the lower limits of its growth in intertidal zones *S. esteroa* occurs rarely in the Regularly Flooded Estuarine Emergent Wetland (Cowardin et al. 1979), associated with *Batis maritima, Salicornia bigelovii* Torr., *S. virginica,* and *Spartina foliosa* Trin.

Suaeda esteroa was apparently collected for the first time in 1875 in the vicinity of San Diego, California (*Cleveland s.n.* (SD)). Although

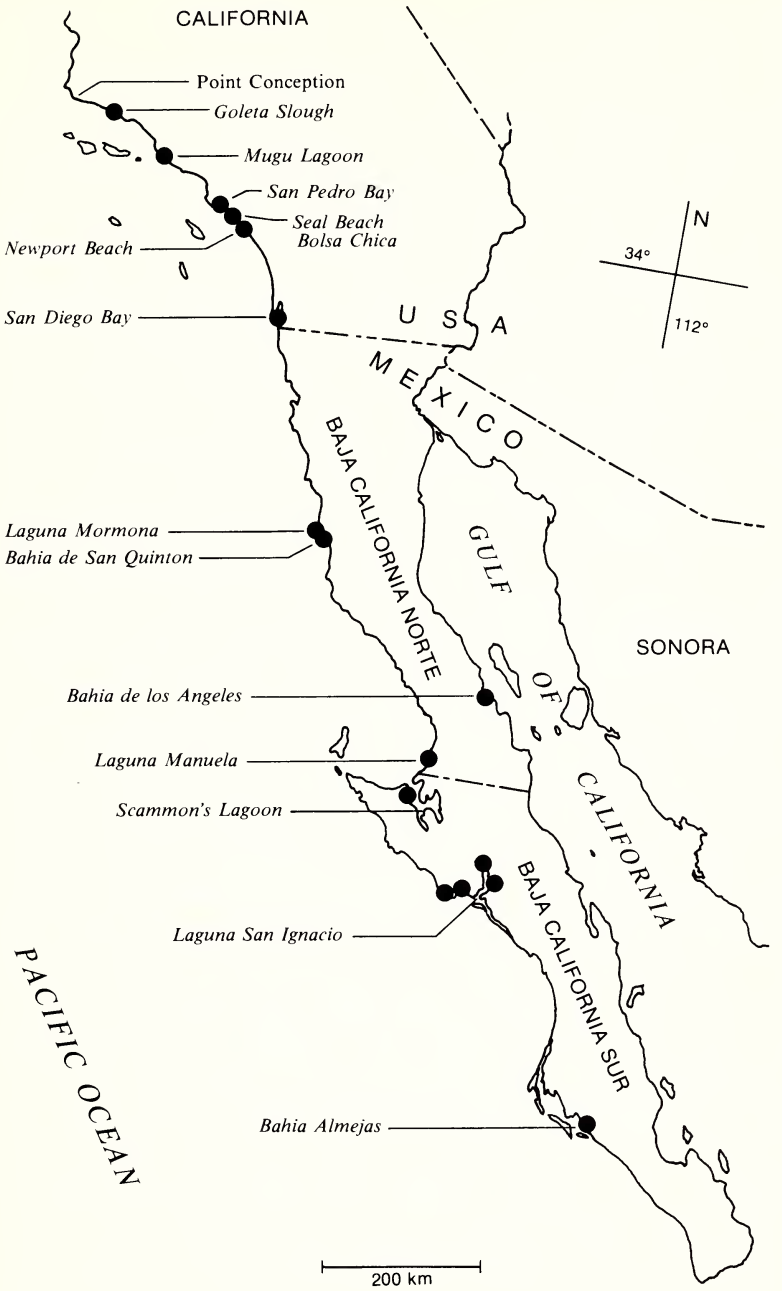

FIG. 2. Distribution of *Suaeda esteroa* based on herbarium specimens. Each dot may represent numerous collections or several adjacent localities.

there are numerous 20th century collections made throughout its range, previous investigators have referred the plant to one of four species of the genus: *S. californica* Wats. var. *californica, S. calceoliformis* (Hook.) Moq., *S. moquinii* (Torr.) Greene, or *S. fruticosa* (L.) Forsk. The latter is a plant of European coastal salt marshes and does not resemble *S. esteroa.* Using various manuals and floras (e.g., Munz 1959, 1974) collectors have named the great majority of specimens of *S. esteroa* as *S. californica* var. *californica,* a plant restricted to the coast of central California. Similar to *S. esteroa,* this plant appears glabrous, and is green (usually not glaucous) and perennial. Unlike *S. esteroa* it has cucullate or rounded (not cucullate and carinate) perianth parts; stigmas pubescent and subtended by a fleshy ring (not glabrous and without a ring); black (not reddish-brown) seeds; flowers in axils on branches and main stems (not restricted to inflorescence); leaves that are not reduced significantly in the inflorescence and are short petiolate or narrowed at the base; and stems that divide at or near the base of the plant often producing a multistemmed, spreading, shrubby habit rather than the decumbent or erect, single-stemmed habit of *S. esteroa.* Furthermore, *S. californica* var. *californica* occurs on coastal bluffs, beaches, berms, and margins of estuaries at elevations higher than the wetland type characterized by *S. esteroa.* At margins of estuaries it occurs in the vicinity of extreme high water and is one element of the Irregularly Flooded Estuarine Scrub/Shrub Wetland. Thus, the two taxa are distinct morphologically, ecologically, and geographically.

The inclusion of *S. esteroa* in *S. californica* var. *californica* has resulted in many reports of the latter plant from southern California. Literature in which plants of *S. esteroa* either are named *S. californica,* or have been included in this species in part, can be divided into three groups: taxonomic treatments (e.g., Standley 1916; Hopkins and Blackwell 1977); floras (e.g., Abrams 1944; Munz 1959, 1974; Shreve and Wiggins 1964; Raven and Thompson 1966; Mason 1969; Smith 1976; Wiggins 1980); as well as phytogeographical and ecological analyses (e.g., Purer 1942; Stevenson and Emery 1958; Vogl 1966; Warme 1971; Macdonald and Barbour 1974; Henrickson 1976; Macdonald 1977; Zedler 1977, 1982). Considerable information about *S. esteroa* is contained in these works. For example, Zedler (1977) reported elevational distribution data for plants fitting the description of *S. esteroa* from the Tijuana Estuary. She found that the plants occurred from about 3 to 13 dm above mean water level, with a peak occurrence (75%) at about 9 dm, where they also reached their greatest cover (ca. 20%). In the region of 9 to 10 dm above sea level she found that *S. esteroa, Frankenia grandifolia,* and *Monanthochloe littoralis* dominated the vegetation. Generally, reports of *S. californica* var. *californica* or glabrous *S. californica* from estuaries south of Point Conception, Santa Barbara County, have been based on plants of *S. esteroa.*

Recognition of *S. esteroa* as a species restricted to estuaries of southern California and Baja California emphasizes further the floristic differences between central and southern California coastal salt marshes. Macdonald and Barbour (1974), Henrickson (1976), and Macdonald (1977) have discussed in detail the environmental and floristic differences between these two groups of estuarine wetlands. They identified a series of plants that characterize or are restricted to each group. The occurrence of *S. californica* var. *californica* in coastal habitats of central California from San Francisco Bay Area south to Morro Bay, San Luis Obispo County, and the occurrence of *S. esteroa* in southern estuaries south of Point Conception, as described herein, are new examples of plants that do not overlap in range. Furthermore, as a result of the description of *S. esteroa,* recognition of the allopatric occurrence of *S. californica* var. *californica* and southern, pubescent, glaucous varieties (var. *pubescens* Jeps. and var. *taxifolia* (Standl.) Munz) provides a more realistic interpretation of infraspecific taxa than reported previously. *Suaeda esteroa* is added to *Monanthochloe littoralis* and *Batis maritima* as a plant restricted to southern estuaries; and both *S. esteroa* and *M. littoralis* reach their northwestern limits south of Point Conception at Goleta Slough.

Although several recent investigations (McNeil et al. 1977, Hopkins and Blackwell 1977, Bassett and Crompton 1978) have clarified some of the taxonomic and nomenclatural problems of North American species of *Suaeda,* various problems remain unresolved. Three problems in California that need work include identity and relationship of desert alkali flat plants, the relationships of infraspecific taxa of *S. californica,* and identity and relationships of these two groups when they occur sympatrically in coastal southern California and Baja California. In spite of these unresolved problems we think it is helpful to provide a key to the California species because of the addition of *S. esteroa* to the flora and the information provided recently by other researchers. However, we suggest that this key serve only as a general guide to the taxa until additional information is available.

Key to coastal central and southern California *Suaeda*

A. Perianth lobes corniculate (horned), unequal; plants annual, glabrous and usually glaucous; stems erect or decumbent, often with red stripes in maturity; leaves greatly reduced in inflorescence. Salt flats and disturbed, open, saline or haline soils; widespread in North America. ..... *S. calceoliformis* (Hook.) Moq. [*S. depressa* (Pursh) Wats., including var. *depressa* and var. *erecta* Wats. (McNeill et al. 1977)]

A. Perianth lobes carinate (keeled) and/or cucullate (hooded) or rounded, unequal or equal; plants perennial, glabrous or pubescent, bright green or glaucous; stems erect, decumbent, or spreading; leaves greatly reduced in inflorescence or similar throughout.

B. Plants glabrous throughout, bright green, yellow green, or occasionally pale glaucous green; perianth lobes carinate and cucullate, unequal; stigmas glabrous, linear, without subtending structures; flowers (1–)3–5 per axil, confined to branches of well-defined inflorescence; bractlets entire-margined; seeds irregularly biconvex, reddish brown; leaves linear, sessile, plane adaxially, convex abaxially, greatly reduced in inflorescence; stems decumbent or erect, usually not divided near base; branches erect. Irregularly flooded, southern coastal salt marshes. ..... *S. esteroa* Ferren & Whitmore

B. Plants appearing glabrous, or pubescent, glaucous or green; perianth lobes cucullate or rounded, usually equal; stigmas pubescent, linear-lanceolate and subtended by a fleshy columnar ring; flowers 1–9 per leaf axil; bractlets usually ciliate, laciniate, or denticulate; seeds regularly biconvex, black; leaves linear, petiolate or at least narrowed at base, terete, subterete, or flat, usually not strongly reduced in inflorescence; stems erect, decumbent, or spreading, usually divided near base; branches divergent. Coastal bluff scrub, beaches, and margins of salt marshes usually above extreme high water.

C. Flowers, including fruiting calyx, 1–2(–2.5) mm broad, usually 1–3 per leaf axil of branches and occasionally main stems; leaves, immature branches, and inflorescence appearing glabrous, or pubescent or puberulent; stems smooth, usually shiny; branches (fresh material) of inflorescence slender (ca. 1(–2) mm wide); leaves usually terete, subterete or flattened, occasionally reduced on branches of inflorescence. (Ventura Co.?) Orange Co. and south; also deserts and interior alkaline valleys. ... *S. moquinii* (Torr.) Greene [*S. torreyana* Wats., including var. *torreyana* and var. *ramosissima* (Standl.) Munz (Basset and Crompton 1978)]

C. Flowers, including fruiting calyx, 1.5–3(–4) mm broad, (1–)3–9 per leaf axil of branches and main stems; plants appearing glabrous, or pubescent; stems usually bearing knobby bases of deciduous leaves, frequently dull; branches (fresh material) of inflorescence stout (1–)2(–3) mm wide; leaves usually subterete, flat, or plane adaxially.

D. Plants green, appearing glabrous, or pubescent on immature branches and inflorescence. San Francisco Bay Area south to Morro Bay, San Luis Obispo Co. ..... *S. californica* Wats. var. *californica*

D. Plants glaucous, occasionally nearly glabrous, to pubescent, puberulent, or densely villous on stems, leaves, and throughout inflorescence. Santa Barbara

Co. and south. .....
... *S. californica* var. *pubescens* Jeps. (as treated here, including var. *taxifolia* (Standl.) Munz. This complex is quite variable, poorly understood, and best treated as a single variety until additional work is done.)

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